Edexcel core science Unit C1b

*Items in **bold** are for higher tier only*

Topic 7 — There's One Earth

This topic provides an opportunity to show how chemists attempt to satisfy demand for useful substances whilst doing all they can to limit the use of natural resources, limit energy consumption and avoid pollution.
Students should consider how useful substances are obtained from the natural resources of the Earth. They should appreciate that these resources are finite and understand that, for the sake of future generations, there is a need to use the resources wisely, recycling whenever possible.
While studying how useful substances are obtained from natural resources, students should understand that, although physical processes are all that are needed in some cases, in the majority of cases chemical reactions are required. These reactions may result in the formation of waste products, which may create environmental problems. A vital contribution from chemists is dealing with these problems and preventing pollution.
As global demand for the use of fossil fuels increases, students need to appreciate the implications of this and the need to identify and use alternative fuels. It is essential that humans take ownership of the need for sustainable energy sources and that they are implemented in all aspects of life.
There are opportunities for students to investigate the properties of a useful fuel and therefore why some fuels are chosen for usage in specific applications. Finally the topic provides an opportunity to widen students' knowledge of the relative advantages and disadvantages of different fuels by introducing the idea of bio-fuels.

Have you ever wondered?

- Why do some scientists need to do their work in exotic locations like Hawaii and Antarctica?
- Will the UK freeze over one day, like in the film 'The Day After Tomorrow'?
- Could we stop global warming by capturing the carbon dioxide we generate instead of letting it escape into the atmosphere?
- Why do we recycle so little of our rubbish in this country?
- What is the cleanest, greenest fuel for a car?
- When oil starts running out, will petrol cost as much as gold?
- Did you know that carbon monoxide can suffocate you to death before you realise it?
- Is there really enough pollution in the air to kill people?

Know that:

- All substances are obtained or made from substances in the Earth's crust, sea or atmosphere.
- Many natural resources are mixtures of substances.
- Products obtained from crude oil are essential to modern life.
- Production and disposal of substances have environmental impacts.

Glossary

acid rain	ignition	combustion	recycle
desalination	sustainability	toxic	viscosity
hydrocarbon	combustion	complete	crude oil
sootiness	fractional	combustion	global warming
bio-fuel	distillation	fractionating	residue
fossil fuel	incomplete	column	

You should be able to:

- recall the formulae of elements and simple compounds in the topic represent chemical reactions by word equations **and simple balanced equations and use state symbols (s), (l), (g) and (aq)**
- **write balanced equations to describe and explain a wide range of reactions.**
- discuss how the idea of global warming went from a single scientist's idea to a widely accepted theory
- recall that hydrocarbons contain carbon and hydrogen only and explain that the products of complete combustion of hydrocarbons are carbon dioxide and water and that energy is released in the reaction
- explain how burning fossil fuels may lead to global warming
- discuss how the composition of the Earth's atmosphere and its temperature have varied over time
- recognise that predictions about the amount of warming of the Earth are based on computer models, which carry uncertainties
- **suggest how to combat the effects of global warming, based on the precautionary principle (which means those proposing the action must demonstrate that the actions suggested are not harmful)**
- explain the importance of recycling waste products such as glass, metal and paper
- evaluate a range of economic and environmental considerations when recycling materials, such as glass and metal, or desalinating sea water in hot countries
- explore how sustainable development involves balancing economic development, maintenance of standards of living, and respect for the environment
- demonstrate an understanding of how the internet can be used to research up-to-date data and information about acid rain or global warming, how to check this data for authenticity and bias, and how to critically analyse and incorporate such data and information into the students' own work
- describe the properties of a useful fuel, including:
    - the sootiness and colour of the flame
    - the heat energy produced
    - the residue
- explain why bio-fuels are sometimes an attractive alternative to fossil fuels
- discuss the benefits and drawbacks of car fuel being changed from petrol to hydrogen fuel
- explain that ethanol obtained from sugar cane or sugar beet is a useful bio-fuel and can be used to reduce the demand for petrol, but it requires large areas of fertile land to produce sufficient quantity
- describe the fractional distillation of crude oil and understand that crude oil is a mixture of substances, most of which are hydrocarbons
- describe the uses of the main fractions of crude oil (gases, petrol, naphtha, kerosene, diesel oil, fuel oil, bitumen)
- **explain where the main fractions of crude oil (gases, petrol, naphtha, kerosene, diesel oil, fuel oil, bitumen) are produced on a fractionating column and relate this to their boiling points, sizes of their molecules, viscosity, ease of ignition and uses**
- explain that incomplete combustion can occur in faulty gas appliances and other heating appliances and that this can be dangerous
- explain that incomplete combustion can produce carbon and carbon monoxide
- recall that carbon monoxide is a toxic gas and explain that it lowers the ability of blood to carry oxygen
- **interpret and evaluate given data relating respiratory diseases such as asthma to atmospheric pollutants**
- describe how nitrogen and oxygen can be obtained by fractional distillation of liquid air
- identify the following substances obtained from seawater and rock salt and recall their uses:
    - sodium; chlorine; sodium chloride; hydrogen; sodium hydroxide.

Topic 8 — Designer Products

In studying this topic students should come to understand how chemists produce products with particular properties which enable them to be used for specific purposes.
Students should understand that the techniques used to manufacture some substances can affect the properties of the products and that new techniques are being developed in the fields of smart materials and nanotechnology.
Students should understand how ethanol is made and should appreciate that all alcoholic drinks contain ethanol and be aware of the possible consequences and social issues regarding excess consumption.

Have you ever wondered?

- How do those glasses that remember their shape work?
- Will scientists one day create toasters that feel 'cuddly' if you touch them gently?
- Why is Gore-Tex™ 'breathable'?
- How can modern body armour, made of soft clothing, stop bullets?
- How do they keep the oil and water in mayonnaise from separating?
- Why do sunscreens now rub in better and no longer leave your skin white?
- Are the new sunscreens that contain nanoparticles safe?
- How do you make beer?
- How does 'intelligent packaging' keep food fresh?
- What would the properties of a perfect hair gel be?

Some facts:
Materials differ in their properties and so are suitable for different purposes.
New materials are developed to meet specific requirements.
Useful substances are made by chemical reactions.
Chemical processes use energy and have environmental consequences.

Glossary

alcohol	Gore-Tex™	nanoparticle	ethanol
fermentation	nanocomposites	Thinsulate™	Kevlar™
Lycra™	Teflon™	emulsifier	smart material
sugar	carbon fibre	hydrophobic	
breathability	hydrophilic	nanotechnology	

You should be able to:

- recall the formulae of elements and simple compounds in the topic represent chemical reactions by word equations **and simple balanced equations and use state symbols (s), (l), (g) and (aq)**
- **write balanced equations to describe and explain a wide range of reactions.**
- use given information to relate properties to some of the uses of modern (carbon fibres, Thinsulate™, Lycra™, etc) and smart materials in clothing, extreme sports and sports equipment
- explain that smart materials can change their properties in response to an external stimulus
- understand that scientists sometimes create new materials with novel properties, such as Teflon™ and the adhesives on Post-it™ notes, when the applications only become apparent afterwards
- explain the breathability of fabrics like Gore-Tex™ in terms of their structure
- demonstrate understanding that the properties of materials dictate their uses, for example, Kevlar™
- compare the size of nanoparticles to that of conventional industrially produced materials, and relate this to their present uses, such as sunscreens and future applications
- **explore risks and uncertainties of nanotechnologies and how they are presented in the media**
- describe how beer and wine can be made by fermentation reactions using yeast to convert sugars into ethanol
- discuss the social issues and possible harmful effects of ethanol in alcoholic drinks